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ABSTRACT

This paper reviews recent literature in the field of fine motor control and training, its theory, practice, and evaluation. The paper is organized into sections dealing with (1) definitions, (2) motor learning in general for developmentally normal and handicapped persons, (3) training methods and concepts, (4) evaluation, (5) other areas, (6) general discussions, and (7) references. It is noted that the inconclusive findings of much of the reported research spotlights the need for considerable additional research effort in many areas. (Author/MP)

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A REVIEW OF RECENT LITERATURE
PERTAINING TO FINE MOTOR CONTROL TRAINING

by
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and
Niki Delgado

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This paper reviews recent literature in the field of fine motor control and training, its theory, practice, and evaluation. The paper is organized into sections dealing with 1) definitions, 2) motor learning in general for developmentally normal and handicapped persons, 3) training methods and concepts, 4) evaluation, 5) other areas, 6) general discussions, and 7) references.

The diversity of research cited in this paper reflects the diversity of the psychomotor domain; the inconclusive findings of much of the reported research only serve to spotlight the need for considerable additional research effort in many areas.

A REVIEW OF RECENT LITERATURE
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The purpose of this paper is to review recent literature in the field of fine motor control and training, its theory, practice, and evaluation. The paper will be organized into sections dealing with:

1. Definitions
2. Motor learning in general, and
 - a. Among developmentally normal individuals,
 - b. As pertains to handicapped persons.
3. Training methods and concepts
4. Evaluation
5. Other areas
6. General discussion

1. Definitions

In this review, the following definitions apply:

Ability: A general trait of the individual, which has been inferred from analysis of certain types of tasks. An ability is independent of other abilities (Fleishman, 1972).

Skill: The level of proficiency in a specific ability

(Fleishman, 1972).

The juxtaposition here of the terms ability and skill helps to illustrate the distinction between them. One may or may not possess skill in some ability, but this does not affect the existence of the ability itself.

Transfer: The application of learning in one area to a related area of performance.

Motor control: The individual's purposeful control of elements of the body structure. The terms psycho-motor and perceptual-motor are sometimes substituted for the word "motor".

Fine motor control: The precise control of the body's musculature.

Gross motor control: Referring to the control of the larger activities of the body.

Fleishman(1972) summarized the results of his extensive study of psychomotor performance. He concluded that there exist at least eleven identifiable psychomotor abilities, each separate and distinct from the others and susceptible to training as discrete attributes of the individual. These abilities are:

1. Control precision
2. Multilimb coordination
3. Response orientation

4. Reaction time
5. Speed of arm movement
6. Rate control
7. Manual dexterity
8. Finger dexterity
9. Arm-hand steadiness
10. Wrist-finger speed
11. Aiming

2. Motor Learning

Several articles and books dealt with motor learning in general.

Arena (1969) and Cherry (1976) discuss the application of fine motor control training to developmentally normal pre-school children. These two references advocate the use of manipulative materials, water play, sand play and mud and dirt play in fine motor development. They also discuss the basic areas of hand-eye coordination, laterality, directionality, body image and awareness and general tactile and kinesthetic approaches to learning.

Varley (1974) suggests that imagery training in pre-school children is facilitated by the integration of motor training. Further they found that sex and socio-economic background played a part.

Miller and Galentu (1970) state that a skill is

developed in several steps: 1) formulation of a "plan", 2) a series of trails (practice) in which various strategies are tested, 3) habituation - a selected strategy is practiced.

A sequence involving first motor training, then perceptual, and finally academic training was employed by Potts and Leyman (1977) to help children having difficulty with the symbolic system of reading. The study showed consistent gains for both groups (first and second grade children). Second graders made less progress.

Fisher (1969) determined after a study involving psychomotor training with EMR children that no improvement was found in psychomotor ability, IQ performance or in achievement.

In the 1971 study by Meckler, fine motor control appears to be trainable but is not dependent on the development of gross motor skill acquisition.

Spano and Burke (1976) found that a certain amount of fatigue (warm-up exercise) does not improve fine motor activities as it does gross motor performance.

One study was found that compared the results of perceptual motor tests for advantaged kindergarten children with test results of disadvantaged (socio-economic) pre-school children (Lietz, 1972). Advantaged children

performed significantly better than disadvantaged children regardless of sex or ethnic background.

Many more studies dealing with motor training for the handicapped were found than were studies for the normal population.

The Meyer Childrens' Rehabilitation Institute (1974) presents many valuable suggestions for training of fine motor control in pre-school, handicapped children. Thornhill (1977) offers a manual for gross and fine motor skills improvement fo handicapped children from kindergarten through grade two. The primary emphasis in fine motor skill development is for paper and pencil tasks as academic preparation.

Slater (1973) developed a motor skills training program for learning disabled kindergarten children. This program involved perceptual training in the areas of gross and fine motor coordination. The study showed that those children who underwent training scored significantly higher in arithmetic skills.

In 1975, Berger reported on a program designed to improve motor skills for handicapped children ages 5 - 21. The experimental group made significant gains in motor skills as a result of training.

Finally Gold (1976) showed that through the use

of task analysis, severely retarded individuals could be taught to perform tasks involving fine motor skills to an acceptable level of competence.

3. Training Methods

The learning of motor skills has been discussed in the literature from a variety of viewpoints.

Motor training models and systems proposed or put into practice generally share certain common features:

1. Focus is on "fine motor skills" in the pre-school and primary school child. Fine motor abilities as manifested in the older (age 10 - up) child are not addressed in any of the sources located.

2. Focus is on everyday activities of the child as developmental indicators. The various abilities combined in execution of tasks are not considered separately, and numerous abilities are not examined at all.

Singer (1972) and Stallings (1973) agree that modern systems of fine motor training must consider all the aspects of fine motor activity. Each element of the spectrum of psychomotor abilities should be included in any training program intended for comprehensive general development.

Gold's (1976) approach to task analysis is reported to have value when applied to the training of fine motor

skills for any population. This is so because each operation is analyzed and broken down into isolated components, according to Gold.

The development of learning strategies in the acquisition of fine motor skills is discussed by Eubanks (1976). The results of Eubanks' studies indicate that such strategies are utilized by the learner, just as in the case in cognitive learning, but there is need for further research into teaching methods and imagery training.

Leonard et al (1970) described a study that indicated that the complexity of the task influences the particular learning strategy produced.

Motor skills are divided into three broad categories by Orendine (1968):

1. Skills developed early in life: walking, speaking, general coordination.
2. Skills used in further educational development: handwriting, reading, typing.
3. Skills taught for their own value: vocational or recreational - sports, industrial arts, science, music, art, home economics.

Orendine's categorization seems useful in the ascribing of value to particular skills, but has little application to training program development.

Orendine also cites research findings that show motor ability developmental potential was related to maturation. The suggestion is made that beginning motor activities begin with large activities. Orendine states that research is needed to establish the maturational points at which the various abilities appear.

Klinger (1966) and Klinger and McNally (1969) have reported studies in the use of imagery in motor skill development. They indicate that their findings were inconclusive, and more research is needed.

Singer and Witker (1970) found that mental practice between practice sessions is of value in improving the effect of motor training, but that the point at which the mental practice is introduced is of little importance.

Transfer of learning is the subject of considerable research.

Work by Orendine (1968), found that adolescents and adults learn new skills more quickly than young children as a result of the transference of previous motor learning.

Siegel, Richlin, and Federman (1960) compared "transfer through generalization" and "transfer through identical elements". Both techniques were found to be productive in training for tasks with clearly-defined performance criteria, but for tasks requiring conceptualization, generalized transfer training was far superior.

Two types of instructional methods (discovery learning and combined discovery/guided instruction) were compared by Singer and Pease (1976). Discovery learning provided better transfer to other motor tasks.

The effect of task complexity to transfer was reported by Leonard (1970). Moving from difficult-to-easy or vice-versa had little effect on transfer, but tasks of equal difficulty showed optimal transfer. Briggs (1969) stated that the evidence in this area is inconclusive.

Meckler (1971), Boswell (1971), and Dunham (1975) agree that the principle of transfer of learning can be generally applied to motor learning, but that the degree of transference is subject to appreciable variability between individuals.

Reinforcement in motor training was found to follow principles similar to those of cognitive learning by many authors, typically Bilodeau and Bilodeau (1961), Smith (1966), and Holding (1969).

Retention also was found to follow a pattern similar to that of cognitive learning: a) Retention is a function of the original level of learning, (Fleishman, 1972), and b) retention diminishes with time (Newmann and Ammons, 1957), c) retention varies with the instructional strategy (Singer and Pease, 1976).

4. Evaluation

More references were found in the area of evaluation of motor skills than any other area.

The Meyer Childrens' Rehabilitation Institute (1974) provides an excellent check-list for fine motor skill development of the pre-school child. Although this list was devised to be used with handicapped children, it is equally valid for a normal population.

Rosentsweig and Herndon (1973), in evaluating Kindergarten children using Kuhlmann-Anderson's Figure Reproduction Test (Herndon's adaptation) and the Pearman revision of the Lincoln-Oseritsky test, suggest that intelligence is not highly related to perceptual-motor skill.

The "Development of the Manual Accuracy and Speed Test (MAST) constructed by Briggs and Tellegen (1971) is for use with children ages 3 - 18 and measures motor abilities of both hands. This test is based on Fleishman's eleven abilities (1972).

Schutz (1975) presents a theoretical discussion of the problems of measuring changes in motor behavior. The Professional Teacher Education Module Series (undated) presents a model for developing a performance evaluation instrument.

Kieffer (1976) deals with the measurement of in-

dividual differences in the skillfull performance of motor tasks. The instruments used for evaluation are General Task Analysis (GTA) and Specific Task Analysis (STA).

Several studies address the relevance of the Bender-Gestalt Test to the measure of perceptual-motor skills (Kerr, 1972; Doubros and Mascarenhas, 1973; Liehsohn and Wagner, 1975; Pascal and Suttell 1951). The majority of these studies indicate that the Bender-Gestalt Test has little relevance to perceptual-motor evaluation.

Botterbush (1974) studied the effects of high and low needs achievement on the scores of potential and non-potential drop-outs. The test used was the "Manual Dexterity Aptitude of the General Aptitude Test Battery". Poor performance seemed to be related to either low needs achievement or being tested individually.

Safrit et al (1977) found, however, that the presence or absence of other observers had no effect on the outcome of test scores in motor performance.

The evaluation instruments for motor control most commonly referred to in the literature include:

1. Lincoln - Oserestsky Motor Development Scale Manual (1954).
2. The Purdue Perceptual Motor Survey (1966)
3. Raven's Progressive Matrices (revised, 1956).
4. Manual For the Mc Carthy Scales of Childrens'

Abilities (1972).

5. U. S. Department of Labor USTES General Aptitude Test Battery, Sec. III (1970).
6. Mc Carron-Dial Work Evaluation System (1976).

5. Other Areas

Literature dealing with a variety of catagories pertinent to fine motor control, but not directly related to the above areas was also reviewed.

The link between motor training and improved reading skills was discussed by Potts and Leyman (1977), Dietrich (1972), and Brinning (1969). The findings of these studies are inconclusive.

The role of background and cultural difference in the acquisition of motor skills is examined by Thomson and Dayries (1975) and Lawther (1968). Both agree that cultural differences can affect the development of motor skills.

Reynolds and Adams (1954) support the theory of individual differences effecting the rate of motor learning and link this to the similar phenomenon in cognitive learning.

Crossman (1970) provides a mathematical treatment of the learning curve as applied to fine motor skills acquisition.

Finally, in a study by Minas (1977), subjects were assigned a series of movements and asked to recall them

verbally and by performance. Motor recall was superior, indicating that there is a specific coding system for remembering sequences of movements.

6. General Discussion

General discussions of motor learning are presented in several volumes. Motor learning is the subject of articles in the "Annual Review of Psychology" for 1961, 1964, and 1968, of collections edited by Bilodeau and Bilodeau (1969), Holding (1969), Legge (1970), and Singer (1972), and of books by Lawther (1968) and Stallings (1973). All of these works provide useful overviews of various aspects of fine motor control, and may prompt valuable insights into questions involving the psychomotor domain.

The diversity of the research described in this paper reflects the diversity of the psychomotor domain; the inconclusive findings of much of the research reported only serves to spotlight the need for considerable additional research effort in many areas.

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